Part I
APPENDIX A. WELD METAL / WELDING PROCEDURE SPECIFICATION TOUGHNESS VERIFICATION TEST

Scope

This appendix supplements Part I, Section 2.4.1, and provides a standard method for qualification testing of weld filler metals required to have specified notch toughness for service in steel moment frames for seismic applications. The WPS Toughness Verification Test may be performed by the filler metal manufacturer or by the Contractor.

Testing and certification of each lot to be used in production shall be performed on each filler metal manufacturer's production lot, as defined in AWS A5.01, *Filler Metal Procurement Guidelines*, as follows:

1. Class C3 for SMAW electrodes,
2. Class S2 for GMAW-S and SAW electrodes,
3. Class T2 for FCAW and GMAW-C, or
4. Class F2 for SAW fluxes.

Alternatively, filler metal manufacturers approved for production of products meeting the above requirements, under a program acceptable to the Engineer, need not conduct the mechanical A5 tests or the Weld Metal / WPS Toughness Verification Test for each lot, and may rely upon the Manufacturer's certifications that the product meets the specified performance requirements.

Test Conditions

Tests shall be conducted at the range of heat inputs for which the weld filler metal will be qualified under the WPS. It is recommended that tests be conducted at the Low Heat Input Level and High Heat Input Level indicated in Table A-1. Alternatively, the filler metal manufacturer or Contractor may elect to test a wider or narrower range of heat inputs and interpass temperatures. The range of heat inputs and interpass temperatures tested shall be clearly stated on the test reports and user data sheets. Regardless of the method of selecting test heat input, the WPS, as used by the Contractor, must fall within the range of heat inputs and interpass temperatures tested.

Table A-1 WPS Toughness Verification Test
Welding and Preheat Conditions

Cooling Rate	Heat Input	Preheat ^{o}F	Interpass ^{o}F
Low Heat Input Test	30 kJ/in.	70 +/- 25	200 +/- 50
High Heat Input Test	80 kJ/in.	300 +/- 25	500 +/- 50

Test Specimens

Two test plates shall be used for each heat input level and five CVN test specimens shall be made per test plate. Each plate shall be steel, of any AISC-listed structural grade. The test plate shall be ¾-inch thick with a ½-inch root opening and 45° included groove angle. The test plate and specimens shall be as shown in Figure 2A in AWS A5.20-95, or as in Figure 5 in AWS A5.29-89R. A minimum of two passes per layer shall be used to fill the width.

All test specimens shall be taken from near the centerline of the weld at the mid-thickness location, in order to minimize dilution effects. CVN specimens shall be prepared in accordance with AWS B4.0-92, *Standard Methods for Mechanical Testing of Welds*, Section A3. The test assembly shall be welded in the flat position and shall be restrained during welding, or preset at approximately 5 degrees to prevent warpage in excess of 5 degrees. A welded test assembly that has warped more than 5 degrees shall be discarded. Welded test assemblies shall not be straightened.

The test assembly shall be tack welded and heated to the specified preheat temperature, measured by temperature indicating crayons or surface temperature thermometers one inch from the center of the groove at the location shown in the figures cited above. Welding shall continue until the assembly has reached the interpass temperature prescribed in Table A-1. The interpass temperature shall be maintained for the remainder of the weld. Should it be necessary to interrupt welding, the assembly shall be allowed to cool in air. The assembly shall then be heated to the prescribed interpass temperature before welding is resumed.

No thermal treatment of weldment or test specimens is permitted, except that machined tensile test specimens may be aged at 200°F to 220°F for up to 48 hours, then cooled to room temperature before testing.

Acceptance Criteria

All test samples shall meet the strength requirements for the electrodes as provided in Part I, Section 2.4.1.1. The lowest and highest values obtained from each of five specimens from a single test plate shall be disregarded. Two of the remaining three values shall equal, or exceed, the specified toughness of 40 ft-lbf energy level at the testing temperature. One of the three may be lower, but not lower than 30 ft-lbf, and the average of the three shall not be less than the required 40 ft-lbf energy level.